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Remarks

The present amendment responds to the Official Action dated October 5, 2006. That Action objected to the drawings and to the specification. Claims 1, 5, and 9 were objected to. The Official Action rejected claims 1-8 under 35 U.S.C. 102(b) as anticipated by Chung "On the Design of Low Density Parity-Check Codes within 0.0045 dB of the Shannon Limit", IEEE Communications Letters, Vol. 5, No. 2, February 2001 ("Chung"). Claims 9-12 were allowed. The objections and sole ground of rejection are addressed below following a brief discussion of the present invention to provide context. The specification has been amended. Claims 1-12 are presently pending.

The Present Invention

A wireless communication system according to one aspect of the present invention includes a plurality of transceivers for conducting communication using binary data transmissions. Each binary transmission is encoded and decoded using a low density parity check (LDPC) code designed using the techniques of the present invention. Each transceiver includes a transmitter which transmits data in the form of an encoded bit stream. The bit stream is encoded using an LDPC code having a design rate near the capacity of the channel over which communication is conducted. The LDPC code comprises a set of codewords that produce valid results when submitted to a validator comprising a set of variable nodes and a set of check nodes, with outputs of the variable nodes being connected to inputs of the check nodes by interleaver edges. Each check node is in the form of a code, with the output of a check node being valid if its inputs form a valid codeword. Each variable node is likewise in the form of a code whose

PAGE 9/14 * RCVD AT 1/4/2007 4:23:32 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/22 * DNIS:2738300 * CSID:9198061690 * DURATION (mm-ss):04-38

outputs are valid if its inputs are valid codewords of the code. The validator may suitably be constructed by plotting information transfer properties of the check nodes using an extrinsic information transfer function (EXIT) chart to form a check node curve and matching a variable node curve to the check node curve, insuring that the variable node curve lies above the check node curve but as close to it as possible, and that the variable node curve closely follows the check node curve. The variable nodes are then constructed so as to provide the information transfer properties indicated by the variable node curve, and the code defined by the validator is used to encode data for transmission.

The Objection to the Drawings

The Official Action objected to the drawings, stating that the legend in Fig. 6, step 602, is improperly phrased. This objection is respectfully traversed. The variable nodes and check nodes used to provide a definition of a low density parity check (LDPC) code according to the present invention are not simply symbols of codes and codewords. Rather, each check node and each variable node is in fact a code, that is, a definition that can be used to identify some combinations of bits as valid codewords and other combinations of bits as invalid and not meeting the definitions for codewords as defined by the code. See, for example, specification, paragraph [0008], which states that "each check node is in the form of a code, with the outputs of a check node being valid if its inputs form a valid codeword", and that "[e]ach variable node is likewise in the form of a code whose outputs are valid if its inputs are valid codewords of the code." See also, specification, paragraphs [0023] and [0024]. In particular, paragraph [0024] states that "[t]he variable nodes 302A-302D and the check nodes 304A and 304B may be thought

PAGE 10/14 * RCVD AT 1/4/2007 4:23:32 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/22 * DNIS:2738300 * CSID:9198061690 * DURATION (mm-ss):04-38

of as analogous to encoders operating according to selected coding arrangements." The overall structure of an LDPC code according to an aspect of the present invention may be defined in terms of check nodes and variable nodes and their relationships. This structure may be conveniently represented by a graph, but the check nodes, variable nodes, and the structure of their relationship may be thought of as comprising definitions, rather than simply representations of graphical symbols. Therefore, the legend appearing in Fig, 6, step 602, is appropriate and accurately describes the operation referred to. The objection to the drawings should therefore be withdrawn.

The Objections to the Specification

The Official Action objected to the specification, specifically to the references to check nodes and variable nodes having the form of codes. Such references appear, for example, in the Abstract and in paragraphs [0008] and [0082]. As noted above with respect to the objection to the drawings, such a reference accurately describes the check nodes and variable nodes, which can be thought of as definitions of valid inputs. The check nodes and variable nodes may conveniently be represented by symbols appearing on a graph, but may also be thought of as existing independently of such symbols. Although the overall structure of the variable nodes and check nodes and their relationships defines a code, that is, the LDPC code being designed, each individual check node and variable node defines a code as well. Each individual check node defines a set of valid inputs to the check node, as does each individual variable node. Therefore, it is appropriate to refer to the variable nodes and check nodes as codes, rather than referring to the variable nodes and check nodes as symbols of codes, or to the couplings between the

PAGE 11/14 * RCVD AT 1/4/2007 4:23:32 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/22 * DNIS:2738300 * CSID:9198061690 * DURATION (mm-ss):04-38

variable nodes and check nodes as defining a code. The overall structure, including the variable nodes and check nodes and their couplings, defines the LDPC code, but that definition includes definitions of codes imposed by each individual variable node and check node. The objection to the references to variable nodes check nodes having the form of codes appearing in the Abstract, and to check nodes having the form of codes appearing in paragraphs [0008] and [0082] should therefore be withdrawn.

The Official Action also objected to the specification on the ground that it was unclear how an EXIT curve is plotted for check nodes without variable nodes, because decoding proceeds with information exchange between check nodes and variable nodes. The set of check nodes, and the set of variable nodes, each have information transfer properties that can be plotted using an EXIT curve. Details of the plotting of an EXIT curve for a set of check nodes are found in paragraph [0068], which states that each code used for a check node has its own characteristic EXIT curve, and EXIT curves for a mixture of code types may be combined according to a weighting determined by the number of output edges for each code type.

The Official Action further objected to the specification on the ground that "a set of codewords meeting code constraints" appearing in step 608, is already defined by the relationships between the check nodes and variable nodes. This reference appears in the drawings, but not in the specification as originally filed. However, the specification has been amended to include a description of step 608 corresponding to the description appearing in Fig. 6. Such a step is appropriate because the selection of check nodes and variable nodes, and the definition of their relationships, defines all possible codewords, but it may not be desired to use

all possible codewords. Therefore, a set of codewords meeting the code constraints may be defined, with this set being less comprehensive than a set of all possible codewords. The objections to the specification should therefore be withdrawn.

Objections to the Claims

The Official Action objected to claims 1, 5, and 9, on the ground that the references to check nodes and variable nodes in the form of codes is inappropriate. As discussed above in connection with the objections to the drawings and the specification, such a reference is appropriate and properly describes the invention. The objections to the claims have therefore been overcome and should be withdrawn.

The Art Rejections

All of the art rejections are based on Chung, standing alone. As addressed in greater detail below, Chung does not support the Official Action's reading of it and the rejections based thereupon should be reconsidered and withdrawn. Further, the Applicants do not acquiesce in the analysis of Chung made by the Official Action and respectfully traverse the Official Action's analysis underlying its rejections.

The Official Action rejected claims 1-8 under 35 U.S.C. 102(b) as anticipated by Chung. This ground of rejection is respectfully traversed. The Official Action states that Chung discloses rate-1/2 irregular LDPC codes that come within 0.0045 dB of the Shannon limit, for correcting errors caused by transmission on a binary AWGN channel, and that Chung therefore provides a generalized low density parity check (LDPC) code whose variable nodes and check nodes are codes and which is designed to provide for successful decoding to convergence at a

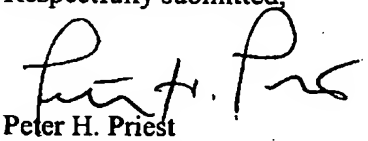
PAGE 13/14 * RCVD AT 1/4/2007 4:23:32 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/22 * DNIS:2738300 * CSID:9198061690 * DURATION (mm-ss):04-38

code rate near the capacity of a channel over which communication occurs. The Applicants respectfully disagree with this proposition. The Applicants do not see in Chung any reference to the use of codes as check nodes and variable nodes. Instead, Chung describes an implementation of density evolution, referred to by Chung as discretized density evolution. This technique does not teach and does not make obvious the present invention as claimed by claim 1. Claims 1-8 therefore define over the cited art and should be allowed.

Conclusion

All of the presently pending claims, as amended, appearing to define over the applied references, withdrawal of the present rejection and prompt allowance are requested.

Respectfully submitted,



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PAGE 14/14 * RCVD AT 1/4/2007 4:23:32 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/22 * DNIS:2738300 * CSID:9198061690 * DURATION (mm-ss):04-38